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Name

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Nishida et al.
Serial No. : Unknown
Filed: : January 17, 2002
For : Color Proofing Method And Apparatus,
And Recorded Medium On Which Color
Proofing Program Is Recorded
Examiner : Unknown
Group Art Unit : 3724

Commissioner for Patents
Washington, DC 20231

AMENDMENT UNDER 37 CFR 1.111

Sir:

Prior to the first Office Action, the Applicants amend
and remark as follows:

In the Specification:

On page 1, between lines 3 and 4, insert

-- CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority from PCT/JP99/03886.--.

On page 6, line 18 through page 18, line 16, delete "a color proofing method for, . . .M_n and Y_n, respectively." and insert -- a color proofing method for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press, the color proofing method comprising the steps of: creating a look-up table containing converted values of image data over the entire color space with respect to the proof press; correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print; making proof print by the use of the corrected look-up table; in the case where the proof print is produced based on area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the step of correcting the look-up table includes the steps of: determining a paper exposed area factor α in accordance with the following equation when arbitrary reference data P in the look-up table has color values (C_p, M_p, Y_p, B_{kp}), each of which is N-bit data:

$$\alpha = (1 - C_p / (2^N - 1)) \times (1 - M_p / (2^N - 1)) \times (1 - Y_p / (2^N - 1)) \times (1 - B_{kp} / (2^N - 1)),$$
 in contrast, determining the paper exposed area factor α in accordance with the following equation when the

arbitrary reference data P in the look-up table has the color values (Cp, Mp, Yp, Bkp), each of which is percentage data:

$\alpha = (1 - C_p/100) \times (1 - M_p/100) \times (1 - Y_p/100) \times (1 - B_{kp}/100)$; and determining corrected values (Ci', Mi', Yi', Bki') of color values (Ci, Mi, Yi, Bki) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (Ca, Ma, Ya, Bka) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%:

$Ci' = Ci + Ca \times \alpha$, $Mi' = Mi + Ma \times \alpha$, $Yi' = Yi + Ya \times \alpha$ and $Bki' = Bki + Bka \times \alpha$, to thus replace the color values of the reference data with the corrected values.

Furthermore, in order to solve the above-described problems, according to the present invention, there is provided a color proofing method for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press, the color proofing method comprising the steps of: creating a look-up table containing converted values of image data over the entire color space with respect to the proof press; correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print; making proof print by the use of the corrected look-up table; in the case where the proof print is produced based on both of density gradation and area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the step of correcting the look-up table includes the steps of: specifying an

influence range defining how far reference data is influenced in the color space when the color values of the printing paper for the printing press are added to the color space; and determining an influence value for each of the reference data based on the color values of the paper and the value of the influence range, to thus add the influence value to the reference data.

Moreover, in order to solve the above-described problems, according to the present invention, there is provided a color proofing method for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press, the color proofing method comprising the steps of: creating a look-up table containing converted values of image data over the entire color space with respect to the proof press; correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print; making proof print by the use of the corrected look-up table; in the case where the colors of the printing paper for the printing press and a printing paper for the proof press are different from each other to such an extent as to need to take the ink transmittance into account, the step of correcting the look-up table includes the step of: determining corrected values (C_i' , M_i' , Y_i' , B_{ki}') of color values (C_i , M_i , Y_i , B_{ki}) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (C_a , M_a , Y_a , B_{ka}) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%, wherein address values (C_{id} , M_{id} , Y_{id} , B_{kid}) express the color values (C_i , M_i , Y_i , B_{ki}) by N-bit:

$$C_i' = C_i + C_a \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1));$$

$Mi' = Mi + Ma \times (1 - Cid / (2^N - 1) \times Mid / (2^N - 1) \times Yid / (2^N - 1) \times Bkid / (2^N - 1));$

$Yi' = Yi + Ya \times (1 - Cid / (2^N - 1) \times Mid / (2^N - 1) \times Yid / (2^N - 1) \times Bkid / (2^N - 1));$ and

$Bki' = Bki + Bka \times (1 - Cid / (2^N - 1) \times Mid / (2^N - 1) \times Yid / (2^N - 1) \times Bkid / (2^N - 1));$ to thus replace the color values of the reference data with the corrected values.

According to a preferred embodiment of the above-mentioned first to third inventions, the step of creating the proof print includes the step of: changing image data converted by using the corrected look-up table based on the previously determined noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press, to thus make the proof print by the use of the changed image data.

Furthermore, in order to solve the above-described problems, according to the present invention, there is provided a color proofing method for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press, the color proofing method comprising the step of: correcting proof printing image data, in which each of levels of monochromatic color gradation of black on the printed matter is represented on the proof print, out of the proof printing image data over the entire color space in a subtractive process resulting from color matching between proof print produced by the proof press and the printed matter to be produced by the printing press in such a manner that a part having a black ink area factor of 100% on the printed

matter is represented only with black ink also on the proof print, but that a part other than the part having a black ink area factor of 100% on the printed matter is represented on the proof print by using under color removal, to thus reproduce, on the proof print, the representing characteristics of the black ink on the printed matter.

According to a preferred embodiment of the above-mentioned fourth invention, the step of correcting the proof printing image data includes the steps of: finding $\min(C_{100}, M_{100}, Y_{100})$ from color values $(C_{100}, M_{100}, Y_{100}, Bk_{100})$ of the proof printing image data for representing, on the proof print, the part having the black ink area factor of 100% on the printed matter, to thus determine a new value P of Bk_{100} ; finding an addition value α_{100} for Bk_{100} in accordance with the following equation:

$$\alpha_{100} = \min(C_{100}, M_{100}, Y_{100}) \times (P - Bk_{100}) / \min(C_{100}, M_{100}, Y_{100}),$$
wherein $1 \leq P \leq 100$;

adding the addition value α_{100} to Bk_{100} as well as setting all of C_{100} , M_{100} and Y_{100} to 0; and repeating, with respect to n from 99 to 1, the following steps of: determining $\min(C_n, M_n, Y_n)$ from color values (C_n, M_n, Y_n, Bk_n) of the proof printing image data for representing, on the proof print, a part having a black ink area factor of $n\%$ on the printed matter; determining an addition value α_n with respect to Bk_n in accordance with the following equation:

$$\alpha_n = (\min(C_n, M_n, Y_n) - (100 - n)) \times (P - Bk_{100}) / \min(C_{100}, M_{100}, Y_{100}),$$
wherein $1 \leq P \leq 100$, to thus add the addition value α_n to Bk_n ; and obtaining respective reduction values β_n , γ_n and δ_n of C_n , M_n and Y_n in accordance with the following equations:

$$\beta_n = \alpha_n \times ((P - Bk_{100}) / C_{100}),$$

$$\gamma_n = \alpha_n \times ((P - Bk_{100}) / M_{100}), \text{ and}$$

$$\delta_n = \alpha_n \times ((P - Bk_{100}) / Y_{100}),$$

wherein $1 \leq P \leq 100$, to thus subtract the reduction values β_n , γ_n and δ_n of C_n , M_n and Y_n , respectively.

Additionally, in order to solve the above-described problems, according to the present invention, there is provided a color proofing apparatus for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing apparatus comprising: a look-up table creating section for creating a look-up table including converted values of image data over the entire color space with respect to the proof press; a noise strength and distribution amount input section for setting the noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press; a paper color input section for specifying the color of the printing paper for the printing press; a look-up table correcting section for correcting the look-up table based on the color inputted to the paper color input section and a paper exposed area factor in the proof print; an image data converting section for changing the image data converted by the use of the look-up table corrected by the look-up table correcting section based on the noise strength and distribution amount inputted to the noise strength and distribution amount input section, to thus output the changed image data; in the case where the proof print is produced based on only area gradation and the colors of the

printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the look-up table correcting section includes: a paper exposed area factor calculating section for determining a paper exposed area factor α in accordance with the following equation when arbitrary reference data P in the look-up table has color values (Cp, Mp, Yp, Bkp), each of which is N-bit data:

$$\alpha = (1 - C_p / (2^N - 1)) \times (1 - M_p / (2^N - 1)) \times (1 - Y_p / (2^N - 1)) \times (1 - B_{kp} / (2^N - 1))$$
, in contrast, determining the paper exposed area factor α in accordance with the following equation when the arbitrary reference data P in the look-up table has the color values (Cp, Mp, Yp, Bkp), each of which is percentage data:

$$\alpha = (1 - C_p / 100) \times (1 - M_p / 100) \times (1 - Y_p / 100) \times (1 - B_{kp} / 100)$$
; and a color corrected value calculating section for determining corrected values (Ci', Mi', Yi', Bki') of color values (Ci, Mi, Yi, Bki) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (Ca, Ma, Ya, Bka) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%:

$$C_i' = C_i + C_a \times \alpha, M_i' = M_i + M_a \times \alpha, Y_i' = Y_i + Y_a \times \alpha \text{ and } B_{ki}' = B_{ki} + B_{ka} \times \alpha$$
, to thus replace the color values of the reference data with the corrected values.

Furthermore, in order to solve the above-described problems, according to the present invention, there is provided a color proofing apparatus for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a

computer, the color proofing apparatus comprising: a look-up table creating section for creating a look-up table including converted values of image data over the entire color space with respect to the proof press; a noise strength and distribution amount input section for setting the noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press; a paper color input section for specifying the color of the printing paper for the printing press; a look-up table correcting section for correcting the look-up table based on the color inputted to the paper color input section and a paper exposed area factor in the proof print and an image data converting section for changing the image data converted by the use of the look-up table corrected by the look-up table correcting section based on the noise strength and distribution amount inputted to the noise strength and distribution amount input section, to thus output the changed image data; in the case where the proof print is produced based on both of density gradation and area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the look-up table correcting section includes: an influence range input section for specifying an influence range defining how far reference data is influenced in the color space when the color values of the printing paper for the printing press are added to the color space; and an influence value calculating section for determining an influence value for each of the reference data based on the color values of the paper and the value of the influence range, to thus add the influence value to the reference data.

Furthermore, in order to solve the above-described problems, according to the present invention, there is provided a color proofing apparatus for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing apparatus comprising: a look-up table creating section for creating a look-up table including converted values of image data over the entire color space with respect to the proof press; a noise strength and distribution amount input section for setting the noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press; a paper color input section for specifying the color of the printing paper for the printing press; a look-up table correcting section for correcting the look-up table based on the color inputted to the paper color input section and a paper exposed area factor in the proof print and an image data converting section for changing the image data converted by the use of the look-up table corrected by the look-up table correcting section based on the noise strength and distribution amount inputted to the noise strength and distribution amount input section, to thus output the changed image data; in the case where the colors of the printing paper for the printing press and a printing paper for the proof press are different from each other to such an extent as to need to take the ink transmittance into account, the look-up table correcting section includes: a second color corrected value calculating section for determining corrected values (C_i' , M_i' , Y_i' , B_{ki}') of color values (C_i , M_i , Y_i , B_{ki}) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (C_a , M_a , Y_a , B_{ka}) of the printing paper for the printing press are added to a part where

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a paper exposed area factor is 100%, wherein address values (Cid, Mid, Yid, Bkid) express the color values (Ci, Mi, Yi, Bki) by N-bit:

$$Ci' = Ci + Ca \times (1 - Cid/(2^N - 1) \times Mid/(2^N - 1) \times Yid/(2^N - 1) \times Bkid/(2^N - 1));$$

$$Mi' = Mi + Ma \times (1 - Cid/(2^N - 1) \times Mid/(2^N - 1) \times Yid/(2^N - 1) \times Bkid/(2^N - 1));$$

$$Yi' = Yi + Ya \times (1 - Cid/(2^N - 1) \times Mid/(2^N - 1) \times Yid/(2^N - 1) \times Bkid/(2^N - 1)); \text{ and}$$

$Bki' = Bki + Bka \times (1 - Cid/(2^N - 1) \times Mid/(2^N - 1) \times Yid/(2^N - 1) \times Bkid/(2^N - 1));$ to thus replace the color values of the reference data with the corrected values.

Furthermore, in order to solve the above-described problems, according to the present invention, there is provided a color proofing apparatus for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing apparatus comprising: an image data input section for receiving an input of proof printing image data over the entire color space in a subtractive process resulting from color matching between proof print produced by the proof press and the printed matter produced by the printing press; and an image data correcting section for correcting the proof printing image data, in which each of levels of monochromatic color gradation of black on the printed matter is represented on the proof print, out of the image data inputted to the image data input section in such a manner that a part having a black ink area factor of 100% on the printed matter is

represented only with black ink also on the proof print, but that a part other than the part having a black ink area factor of 100% on the printed matter is represented on the proof print by using under color removal, to thus output the corrected image data.

According to a preferred embodiment of the above-mentioned eighth invention, the image data correcting section includes: a 100% black part image data correcting section for determining $\min(C_{100}, M_{100}, Y_{100})$ from color values $(C_{100}, M_{100}, Y_{100}, Bk_{100})$ of the proof printing image data for representing, on the proof print, the part having the black ink area factor of 100% on the printed matter, to thus determine a new value P of Bk_{100} , determining an addition value α_{100} for Bk_{100} in accordance with the following equation:

$$\alpha_{100} = \min(C_{100}, M_{100}, Y_{100}) \times (P - Bk_{100}) / \min(C_{100}, M_{100}, Y_{100}),$$
wherein $1 \leq P \leq 100$, and then, adding the addition value α_{100} to Bk_{100} as well as setting all of C_{100} , M_{100} and Y_{100} to 0; and a 99% or less black part image data correcting section for repeating, with respect to n from 99 to 1, the following processes of: determining $\min(C_n, M_n, Y_n)$ from color values (C_n, M_n, Y_n, Bk_n) of the proof printing image data for representing, on the proof print, a part having a black ink area factor of $n\%$ on the printed matter; determining an addition value α_n for Bk_n in accordance with the following equation:

$$\alpha_n = (\min(C_n, M_n, Y_n) - (100 - n)) \times (P - Bk_{100}) / \min(C_{100}, M_{100}, Y_{100}),$$
wherein $1 \leq P \leq 100$, to thus add the addition value α_n to Bk_n ; and determining respective reduction values β_n , γ_n and δ_n , of C_n , M_n , and Y_n , in accordance with the following equations:

$$\beta = \alpha_n \times ((P - Bk_{100}) / C_{100}),$$

$$\gamma = \alpha_n \times ((P - Bk_{100}) / M_{100}), \text{ and}$$

$$\delta = \alpha_n \times ((P - Bk_{100}) / Y_{100}),$$

wherein $1 \leq P \leq 100$, to thus subtract the reduction values β_n , γ_n and δ_n , of C_n , M_n , and Y_n , respectively.

Furthermore, in order to solve the above-described problems, according to the present invention, there is provided a recorded medium recording therein a color proofing program for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing program instructing the computer to execute the processes of: creating a look-up table containing converted values of image data over the entire color space with respect to the proof press; correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print; creating proof print by the use of the corrected look-up table; in the case where the proof print is produced based on only area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the look-up table correcting process includes the processes of: determining a paper exposed area factor α in accordance with the following equation when arbitrary reference data P in the look-up table has color values (C_p, M_p, Y_p, Bkp) , each of which is N-bit data:

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$\alpha = (1 - C_p / (2^N - 1)) \times (1 - M_p / (2^N - 1)) \times (1 - Y_p / (2^N - 1)) \times (1 - B_{kp} / (2^N - 1))$, in contrast, determining the paper exposed area factor α in accordance with the following equation when the arbitrary reference data P in the look-up table has the color values (Cp, Mp, Yp, Bkp), each of which is percentage data:

$\alpha = (1 - C_p / 100) \times (1 - M_p / 100) \times (1 - Y_p / 100) \times (1 - B_{kp} / 100)$; and determining corrected values (Ci', Mi', Yi', Bki') of color values (Ci, Mi, Yi, Bki) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (Ca, Ma, Ya, Bka) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%:

$Ci' = Ci + Ca \times \alpha$, $Mi' = Mi + Ma \times \alpha$, $Yi' = Yi + Ya \times \alpha$ and $Bki' = Bki + Bka \times \alpha$, to thus replace the color values of the reference data with the corrected values.

In addition, in order to solve the above-described problems, according to the present invention, there is provided a recorded medium recording therein a color proofing program for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing program instructing the computer to execute the processes of: creating a look-up table containing converted values of image data over the entire color space with respect to the proof press; correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print; creating proof print by the use of the corrected look-up table; in the case where the proof print is produced based on both of density gradation and area gradation

and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the look-up table correcting process includes the processes of: specifying an influence range defining how far reference data is influenced in the color space when the color values of the printing paper for the printing press are added to the color space; and determining an influence value for each of the reference data based on the color values of the paper and the value of the influence range, to thus add the influence value to the reference data.

Moreover, in order to solve the above-described problems, according to the present invention, there is provided a recorded medium recording therein a color proofing program for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing program instructing the computer to execute the processes of: creating a look-up table containing converted values of image data over the entire color space with respect to the proof press; correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print; creating proof print by the use of the corrected look-up table; in the case where the colors of the printing paper for the printing press and a printing paper for the proof press are different from each other to such an extent as to need to take the ink transmittance into account, the look-up table correcting process includes the processes of: determining corrected values (C_i' , M_i' , Y_i' , B_{ki}') of color values (C_i , M_i , Y_i , B_{ki}) of arbitrary reference data I in the look-up table in accordance

with the following equations when color values (Ca, Ma, Ya, Bka) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%, wherein address values (Cid, Mid, Yid, Bkid) express the color values (Ci, Mi, Yi, Bki) by N-bit:

$$Ci' = Ci + Ca \times (1 - Cid/(2^N - 1) \times Mid/(2^N - 1) \times Yid/(2^N - 1) \times Bkid/(2^N - 1));$$

$$Mi' = Mi + Ma \times (1 - Cid/(2^N - 1) \times Mid/(2^N - 1) \times Yid/(2^N - 1) \times Bkid/(2^N - 1));$$

$$Yi' = Yi + Ya \times (1 - Cid/(2^N - 1) \times Mid/(2^N - 1) \times Yid/(2^N - 1) \times Bkid/(2^N - 1)); \text{ and}$$

$Bki' = Bki + Bka \times (1 - Cid/(2^N - 1) \times Mid/(2^N - 1) \times Yid/(2^N - 1) \times Bkid/(2^N - 1));$ to thus replace the color values of the reference data with the corrected values.

According to a preferred embodiment of the above-mentioned ninth to eleventh invention, the proof print creating process includes the process of: changing image data converted by using the corrected look-up table based on the previously determined noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press, to thus create the proof print by the use of the changed image data.

Furthermore, in order to solve the above-described problems, according to the present invention, there is provided a recording medium recording therein the color proofing program for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof

press by the use of a computer, the color proofing program further instructing the computer to execute the process of: correcting proof printing image data, in which each of levels of monochromatic color gradation of black on the printed matter is represented on the proof print, out of the proof printing image data over the entire color space in a subtractive process resulting from color matching between proof print by the proof press and the printed matter by means of the printing press in such a manner that a part having a black ink area factor of 100% on the printed matter is represented only with black ink also on the proof print, but that a part other than the part having a black ink area factor of 100% on the printed matter is represented on the proof print by using under color removal, to thus reproduce, on the proof print, the representing characteristics of the black ink on the printed matter.

According to a preferred embodiment of the above-mentioned twelfth invention, the proof printing image data correcting process includes the processes of: determining $\min(C_{100}, M_{100}, Y_{100})$ from color values $(C_{100}, M_{100}, Y_{100}, Bk_{100})$ of the proof printing image data for representing, on the proof print, the part having the black ink area factor of 100% on the printed matter, to thus determine a new value P of Bk_{100} ; determining an addition value α_{100} for Bk_{100} in accordance with the following equation:

$$\alpha_{100} = \min(C_{100}, M_{100}, Y_{100}) \times (P - Bk_{100}) / \min(C_{100}, M_{100}, Y_{100}),$$
 wherein $1 \leq P \leq 100$; adding the addition value α_{100} to Bk_{100} as well as setting all of C_{100} , M_{100} and Y_{100} to 0; and repeating, with respect to n from 99 to 1, the following processes of: determining $\min(C_n, M_n, Y_n)$ from color values (C_n, M_n, Y_n, Bk_n) of the proof printing image data for representing, on the proof

print, a part having a black ink area factor of n% on the printed matter; determining an addition value α_n for Bk_n in accordance with the following equation:

$$\alpha_n = (\min(C_n, M_n, Y_n) - (100 - n)) \times (P - Bk_{100}) / \min(C_{100}, M_{100}, Y_{100}),$$
wherein $1 \leq P \leq 100$, to thus add the addition value α_n to Bk_n ; and determining respective reduction values β_n , γ_n and δ_n , of C_n , M_n and Y_n in accordance with the following equations:

$$\beta_n = \alpha_n \times ((P - Bk_{100}) / C_{100}),$$

$$\gamma_n = \alpha_n \times ((P - Bk_{100}) / M_{100}), \text{ and}$$

$$\delta_n = \alpha_n \times ((P - Bk_{100}) / Y_{100}),$$

wherein $1 \leq P \leq 100$, to thus subtract the reduction values β_n , γ_n and δ_n , from C_n , M_n , and Y_n , respectively. --.

In the Claims:

Cancel claims 1, 8 and 14.

2. (Amended) A color proofing method for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press, the color proofing method comprising the steps of:

creating a look-up table containing converted values of image data over the entire color space with respect to the proof press;

correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print;

cancel claims 1, 8 and 14

making proof print by the use of the corrected look-up table;

in the case where the proof print is produced based on area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the step of correcting the look-up table includes the steps of:

determining a paper exposed area factor α in accordance with the following equation when arbitrary reference data P in the look-up table has color values (Cp, Mp, Yp, Bkp), each of which is N-bit data:

$\alpha = (1 - C_p / (2^N - 1)) \times (1 - M_p / (2^N - 1)) \times (1 - Y_p / (2^N - 1)) \times (1 - B_{kp} / (2^N - 1))$, in contrast, determining the paper exposed area factor α in accordance with the following equation when the arbitrary reference data P in the look-up table has the color values (Cp, Mp, Yp, Bkp), each of which is percentage data:

$$\alpha = (1 - C_p / 100) \times (1 - M_p / 100) \times (1 - Y_p / 100) \times (1 - B_{kp} / 100); \text{ and}$$

determining corrected values (Ci', Mi', Yi', Bki') of color values (Ci, Mi, Yi, Bki) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (Ca, Ma, Ya, Bka) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%:

$Ci' = Ci + Ca \times \alpha$, $Mi' = Mi + Ma \times \alpha$, $Yi' = Yi + Ya \times \alpha$ and $Bki' = Bki + Bka \times \alpha$, to thus replace the color values of the reference data with the corrected values.

3. (Amended) A color proofing method for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press, the color proofing method comprising the steps of:

creating a look-up table containing converted values of image data over the entire color space with respect to the proof press;

correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print;

making proof print by the use of the corrected look-up table;

in the case where the proof print is produced based on both of density gradation and area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the step of correcting the look-up table includes the steps of:

specifying an influence range defining how far reference data is influenced in the color space when the color values of the printing paper for the printing press are added to the color space; and

determining an influence value for each of the reference data based on the color values of the paper and the value of the influence range, to thus add the influence value to the reference data.

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4. (Amended) A color proofing method for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press, the color proofing method comprising the steps of:

creating a look-up table containing converted values of image data over the entire color space with respect to the proof press;

correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print;

making proof print by the use of the corrected look-up table;

in the case where the colors of the printing paper for the printing press and a printing paper for the proof press are different from each other to such an extent as to need to take the ink transmittance into account, the step of correcting the look-up table includes the step of:

determining corrected values (C_i' , M_i' , Y_i' , B_{ki}') of color values (C_i , M_i , Y_i , B_{ki}) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (C_a , M_a , Y_a , B_{ka}) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%, wherein address values (C_{id} , M_{id} , Y_{id} , B_{kid}) express the color values (C_i , M_i , Y_i , B_{ki}) by N-bit:

$$C_i' = C_i + C_a \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1));$$

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$Mi' = Mi + Ma \times (1 - Cid / (2^N - 1) \times Mid / (2^N - 1) \times Yid / (2^N - 1) \times Bkid / (2^N - 1));$

$Yi' = Yi + Ya \times (1 - Cid / (2^N - 1) \times Mid / (2^N - 1) \times Yid / (2^N - 1) \times Bkid / (2^N - 1));$ and

$Bki' = Bki + Bka \times (1 - Cid / (2^N - 1) \times Mid / (2^N - 1) \times Yid / (2^N - 1) \times Bkid / (2^N - 1));$

to thus replace the color values of the reference data with the corrected values.

5. (Amended) The color proofing method according to [any one of claims 1 to] claim 4, wherein the step of creating the proof print includes the step of:

changing image data converted by using the corrected look-up table based on the previously determined noise strength and distribution mount indicating the level of a variation of the color of the printing paper for the printing press, to thus make the proof print by the use of the changed image data.

9. (Amended). A color proofing apparatus for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing apparatus comprising:

a look-up table creating section for creating a look-up table including converted values of image data over the entire color space with respect to the proof press;

a noise strength and distribution amount input section for setting the noise strength and distribution amount indicating

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the level of a variation of the color of the printing paper for the printing press;

a paper color input section for specifying the color of the printing paper for the printing press;

a look-up table correcting section for correcting the look-up table based on the color inputted to the paper color input section and a paper exposed area factor in the proof print;

an image data converting section for changing the image data converted by the use of the look-up table corrected by the look-up table correcting section based on the noise strength and distribution amount inputted to the noise strength and distribution amount input section, to thus output the changed image data;

in the case where the proof print is produced based on only area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the look-up table correcting section includes:

a paper exposed area factor calculating section for determining a paper exposed area factor α in accordance with the following equation when arbitrary reference data P in the look-up table has color values (Cp, Mp, Yp, Bkp), each of which is N-bit data:

$$\alpha = (1 - C_p / (2^N - 1)) \times (1 - M_p / (2^N - 1)) \times (1 - Y_p / (2^N - 1)) \times (1 - B_{kp} / (2^N - 1)),$$

in contrast, determining the paper exposed area factor α in accordance with the following equation when the arbitrary reference data P in the look-up table has the color values (Cp, Mp, Yp, Bkp), each of which is percentage data:

$$\alpha = (1 - C_p/100) \times (1 - M_p/100) \times (1 - Y_p/100) \times (1 - B_{kp}/100); \text{ and}$$

a color corrected value calculating section for determining corrected values (Ci', Mi', Yi', Bki') of color values (Ci, Mi, Yi, Bki) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (Ca, Ma, Ya, Bka) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%:

$$C_i' = C_i + C_a \times \alpha, \quad M_i' = M_i + M_a \times \alpha, \quad Y_i' = Y_i + Y_a \times \alpha \text{ and} \\ B_{ki}' = B_{ki} + B_{ka} \times \alpha,$$

to thus replace the color values of the reference data with the corrected values.

10. (Amended). A color proofing apparatus for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing apparatus comprising:

a look-up table creating section for creating a look-up table including converted values of image data over the entire color space with respect to the proof press;

a noise strength and distribution amount input section for setting the noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press;

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a paper color input section for specifying the color of the printing paper for the printing press;

a look-up table correcting section for correcting the look-up table based on the color inputted to the paper color input section and a paper exposed area factor in the proof print and

an image data converting section for changing the image data converted by the use of the look-up table corrected by the look-up table correcting section based on the noise strength and distribution amount inputted to the noise strength and distribution amount input section, to thus output the changed image data

in the case where the proof print is produced based on both of density gradation and area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the look-up table correcting section includes:

an influence range input section for specifying an influence range defining how far reference data is influenced in the color space when the color values of the printing paper for the printing press are added to the color space; and

an influence value calculating section for determining an influence value for each of the reference data based on the color values of the paper and the value of the influence range, to thus add the influence value to the reference data.

11. (Amended) A color proofing apparatus for improving the color reproducibility of printed matter to be produced by a

printing press in proof print produced by a proof press by the use of a computer, the color proofing apparatus comprising:

a look-up table creating section for creating a look-up table including converted values of image data over the entire color space with respect to the proof press;

a noise strength and distribution amount input section for setting the noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press;

a paper color input section for specifying the color of the printing paper for the printing press;

a look-up table correcting section for correcting the look-up table based on the color inputted to the paper color input section and a paper exposed area factor in the proof print and

an image data converting section for changing the image data converted by the use of the look-up table corrected by the look-up table correcting section based on the noise strength and distribution amount inputted to the noise strength and distribution amount input section, to thus output the changed image data;

in the case where the colors of the printing paper for the printing press and a printing paper for the proof press are different from each other to such an extent as to need to take the ink transmittance into account, the look-up table correcting section includes:

a second color corrected value calculating section for determining corrected values (C_i' , M_i' , Y_i' , B_{ki}') of color

values (Ci, Mi, Yi, Bki) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (Ca, Ma, Ya, Bka) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%, wherein address values (Cid, Mid, Yid, Bkid) express the color values (Ci, Mi, Yi, Bki) by N-bit:

$$Ci' = Ci + Ca \times (1 - Cid / (2^N - 1) \times Mid / (2^N - 1) \times Yid / (2^N - 1) \times Bkid / (2^N - 1));$$

$$Mi' = Mi + Ma \times (1 - Cid / (2^N - 1) \times Mid / (2^N - 1) \times Yid / (2^N - 1) \times Bkid / (2^N - 1));$$

$$Yi' = Yi + Ya \times (1 - Cid / (2^N - 1) \times Mid / (2^N - 1) \times Yid / (2^N - 1) \times Bkid / (2^N - 1)); \text{ and}$$

$$Bki' = Bki + Bka \times (1 - Cid / (2^N - 1) \times Mid / (2^N - 1) \times Yid / (2^N - 1) \times Bkid / (2^N - 1));$$

to thus replace the color values of the reference data with the corrected values.

15. (Amended) A recorded medium recording therein a color proofing program for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing program instructing the computer to execute the processes of:

creating a look-up table containing converted values of image data over the entire color space with respect to the proof press;

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correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print;

creating proof print by the use of the corrected look-up table;

in the case where the proof print is produced based on only area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the look-up table correcting process includes the processes of:

determining a paper exposed area factor α in accordance with the following equation when arbitrary reference data P in the look-up table has color values (Cp, Mp, Yp, Bkp), each of which is N-bit data:

$$\alpha = (1 - C_p / 2^N - 1) \times (1 - M_p / (2^N - 1)) \times (1 - Y_p / (2^N - 1)) \times (1 - B_{kp} / (2^N - 1)),$$

in contrast, determining the paper exposed area factor α in accordance with the following equation when the arbitrary reference data P in the look-up table has the color values (Cp, Mp, Yp, Bkp), each of which is percentage data:

$$\alpha = (1 - C_p / 100) \times (1 - M_p / 100) \times (1 - Y_p / 100) \times (1 - B_{kp} / 100); \text{ and}$$

determining corrected values (Ci', Mi', Yi', Bki') of color values (Ci, Mi, Yi, Bki) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (Ca, Ma, Ya, Bka) of the printing paper for the

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printing press are added to a part where a paper exposed area factor is 100%:

$$C_i' = C_i + C_a \times \alpha, M_i' = M_i + M_a \times \alpha, Y_i' = Y_i + Y_a \times \alpha \text{ and} \\ B_{ki}' = B_{ki} + B_{ka} \times \alpha,$$

to thus replace the color values of the reference data with the corrected values.

16. (Amended) A recorded medium recording therein a color proofing program for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing program instructing the computer to execute the processes of:

creating a look-up table containing converted values of image data over the entire color space with respect to the proof press;

correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print:

creating proof print by the use of the corrected look-up table;

in the case where the proof print is produced based on both of density gradation and area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the look-up table correcting process includes the processes of:

specifying an influence range defining how far reference data is influenced in the color space when the color values of the printing paper for the printing press are added to the color space; and

determining an influence value for each of the reference data based on the color values of the paper and the value of the influence range, to thus add the influence value to the reference data.

17. (Amended) A recorded medium recording therein a color proofing program for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing program instructing the computer to execute the processes of:

creating a look-up table containing converted values of image data over the entire color space with respect to the proof press;

correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print;

creating proof print by the use of the corrected look-up table;

in the case where the colors of the printing paper for the printing press and a printing paper for the proof press are different from each other to such an extent as to need to take the ink transmittance into account, the look-up table correcting process includes the processes of:

determining corrected values (C_i' , M_i' , Y_i' , B_{ki}') of color values (C_i , M_i , Y_i , B_{ki}) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (C_a , M_a , Y_a , B_{ka}) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%, wherein address values (C_{id} , M_{id} , Y_{id} , B_{kid}) express the color values (C_i , M_i , Y_i , B_{ki}) by N-bit:

$$C_i' = C_i + C_a \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1));$$

$$M_i' = M_i + M_a \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1));$$

$$Y_i' = Y_i + Y_a \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1)); \text{ and}$$

$$B_{ki}' = B_{ki} + B_{ka} \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1));$$

to thus replace the color values of the reference data with the corrected values.

18. (Amended) The recorded medium recording therein the color proofing program according to [any one of claims 14 to] claim 17, wherein the proof print creating process includes the process of:

changing image data converted by using the corrected look-up table based on the previously determined noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press, to thus create the proof print by the use of the changed image data.

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21. (New) The color proofing method according to claim 2, wherein the step of creating the proof print includes the step of:

changing image data converted by using the corrected look-up table based on the previously determined noise strength and distribution mount indicating the level of a variation of the color of the printing paper for the printing press, to thus make the proof print by the use of the changed image data.

22. (New) The color proofing method according to claim 3, wherein the step of creating the proof print includes the step of:

changing image data converted by using the corrected look-up table based on the previously determined noise strength and distribution mount indicating the level of a variation of the color of the printing paper for the printing press, to thus make the proof print by the use of the changed image data.

23. (New) The recorded medium recording therein the color proofing program according to claim 15, wherein the proof print creating process includes the process of:

changing image data converted by using the corrected look-up table based on the previously determined noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press, to thus create the proof print by the use of the changed image data.

24. (New) The recorded medium recording therein the color proofing program according to claim 16, wherein the proof print creating process includes the process of:

changing image data converted by using the corrected look-up table based on the previously determined noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press, to thus create the proof print by the use of the changed image data.

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REMARKS

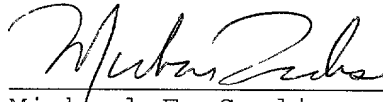
Claims 1 to 24 are pending. Claims 1, 8 and 14 are cancelled. Claims 21 to 24 are new. No claims are allowed.

1. The specification has been amended to more clearly describe the invention. No new matter is added.

2. A clean copy of the amended specification pages and the claims is attached to the end of this amendment.

It is requested that the U.S. Patent Office act on the merits of the pending claims at an early date.

Respectfully submitted,



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Clean Copy of the Claims

2. A color proofing method for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press, the color proofing method comprising the steps of:

creating a look-up table containing converted values of image data over the entire color space with respect to the proof press;

correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print;

making proof print by the use of the corrected look-up table;

in the case where the proof print is produced based on area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the step of correcting the look-up table includes the steps of:

determining a paper exposed area factor α in accordance with the following equation when arbitrary reference data P in the look-up table has color values (Cp, Mp, Yp, Bkp), each of which is N-bit data:

$$\alpha = (1 - C_p / (2^N - 1)) \times (1 - M_p / (2^N - 1)) \times (1 - Y_p / (2^N - 1)) \times (1 - B_{kp} / (2^N - 1)),$$
 in contrast, determining the paper exposed area

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factor α in accordance with the following equation when the arbitrary reference data P in the look-up table has the color values (Cp, Mp, Yp, Bkp), each of which is percentage data:

$$\alpha = (1-Cp/100) \times (1-Mp/100) \times (1-Yp/100) \times (1-Bkp/100); \text{ and}$$

determining corrected values (Ci', Mi', Yi', Bki') of color values (Ci, Mi, Yi, Bki) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (Ca, Ma, Ya, Bka) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%:

$Ci' = Ci + Ca \times \alpha$, $Mi' = Mi + Ma \times \alpha$, $Yi' = Yi + Ya \times \alpha$ and $Bki' = Bki + Bka \times \alpha$, to thus replace the color values of the reference data with the corrected values.

3. A color proofing method for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press, the color proofing method comprising the steps of:

creating a look-up table containing converted values of image data over the entire color space with respect to the proof press;

correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print;

making proof print by the use of the corrected look-up table;

in the case where the proof print is produced based on both of density gradation and area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the step of correcting the look-up table includes the steps of:

specifying an influence range defining how far reference data is influenced in the color space when the color values of the printing paper for the printing press are added to the color space; and

determining an influence value for each of the reference data based on the color values of the paper and the value of the influence range, to thus add the influence value to the reference data.

4. A color proofing method for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press, the color proofing method comprising the steps of:

creating a look-up table containing converted values of image data over the entire color space with respect to the proof press;

correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print;

making proof print by the use of the corrected look-up table;

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in the case where the colors of the printing paper for the printing press and a printing paper for the proof press are different from each other to such an extent as to need to take the ink transmittance into account, the step of correcting the look-up table includes the step of:

determining corrected values (C_i' , M_i' , Y_i' , B_{ki}') of color values (C_i , M_i , Y_i , B_{ki}) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (C_a , M_a , Y_a , B_{ka}) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%, wherein address values (C_{id} , M_{id} , Y_{id} , B_{kid}) express the color values (C_i , M_i , Y_i , B_{ki}) by N-bit:

$$C_i' = C_i + C_a \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1));$$

$$M_i' = M_i + M_a \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1));$$

$$Y_i' = Y_i + Y_a \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1)); \text{ and}$$

$$B_{ki}' = B_{ki} + B_{ka} \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1));$$

to thus replace the color values of the reference data with the corrected values.

5. The color proofing method according to claim 4, wherein the step of creating the proof print includes the step of:

changing image data converted by using the corrected look-up table based on the previously determined noise strength and

distribution mount indicating the level of a variation of the color of the printing paper for the printing press, to thus make the proof print by the use of the changed image data.

6. A color proofing method for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press, the color proofing method comprising the step of:

correcting proof printing image data, in which each of levels of monochromatic color gradation of black on the printed matter is represented on the proof print out of the proof printing image data over the entire color space in a subtractive process resulting from color matching between proof print produced by the proof press and the printed matter to be produced by the printing press in such a manner that a part having a black ink area factor of 100% on the printed matter is represented only with black ink also on the proof print but that a part other than the part having a black ink area factor of 100% on the printed matter is represented on the proof print by using under color removal, to thus reproduce, on the proof print, the representing characteristics of the black ink on the printed matter.

7. The color proofing method according to claim 6, wherein the step of correcting the proof printing image data includes the steps of:

finding $\min(C_{100}, M_{100}, Y_{100})$ from color values $(C_{100}, M_{100}, Y_{100}, Bk_{100})$ of the proof printing image data for representing, on the proof print, the part having the black ink area factor of

100% on the printed matter, to thus determine a new value P of Bk_{100} ;

finding an addition value α_{100} for Bk_{100} in accordance with the following equation:

$$\alpha_{100} = \min(C_{100}, M_{100}, Y_{100}) \times (P - Bk_{100}) / \min(C_{100}, M_{100}, Y_{100}),$$
 wherein $1 \leq P \leq 100$;

adding the addition value α_{100} to Bk_{100} as well as setting all of C_{100} , M_{100} and Y_{100} to 0; and

repeating, with respect to n from 99 to 1, the following steps of:

determining $\min(C_n, M_n, Y_n)$ from color values (C_n , M_n , Y_n , Bk_n) of the proof printing image data for representing, on the proof print, a part having a black ink area factor of $n\%$ on the printed matter;

determining an addition value α_n with respect to Bk_n in accordance with the following equation:

$$\alpha_n = (\min(C_n, M_n, Y_n) - (100 - n)) \times (P - Bk_{100}) / \min(C_{100}, M_{100}, Y_{100}),$$
 wherein $1 \leq P \leq 100$, to thus add the addition value α_n to Bk_n and

obtaining respective reduction values β_n , γ_n and δ_n of C_n , M_n and Y_n in accordance with the following equations:

$$\beta_n = \alpha_n \times ((P - Bk_{100}) / C_{100}),$$

$$\gamma_n = \alpha_n \times ((P - Bk_{100}) / M_{100}), \text{ and}$$

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$\delta_n = \alpha_n \times ((P - Bk_{100}) / Y_{100})$, wherein $1 \leq P \leq 100$, to thus subtract the reduction values β_n , γ_n and δ_n from C_n , M_n and Y_n , respectively.

9. A color proofing apparatus for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing apparatus comprising:

a look-up table creating section for creating a look-up table including converted values of image data over the entire color space with respect to the proof press;

a noise strength and distribution amount input section for setting the noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press;

a paper color input section for specifying the color of the printing paper for the printing press;

a look-up table correcting section for correcting the look-up table based on the color inputted to the paper color input section and a paper exposed area factor in the proof print;

an image data converting section for changing the image data converted by the use of the look-up table corrected by the look-up table correcting section based on the noise strength and distribution amount inputted to the noise strength and distribution amount input section, to thus output the changed image data;

in the case where the proof print is produced based on only area gradation and the colors of the printing paper for the

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printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the look-up table correcting section includes:

a paper exposed area factor calculating section for determining a paper exposed area factor α in accordance with the following equation when arbitrary reference data P in the look-up table has color values (Cp, Mp, Yp, Bkp), each of which is N-bit data:

$$\alpha = (1 - C_p / (2^N - 1)) \times (1 - M_p / (2^N - 1)) \times (1 - Y_p / (2^N - 1)) \times (1 - B_{kp} / (2^N - 1)),$$

in contrast, determining the paper exposed area factor α in accordance with the following equation when the arbitrary reference data P in the look-up table has the color values (Cp, Mp, Yp, Bkp), each of which is percentage data:

$$\alpha = (1 - C_p / 100) \times (1 - M_p / 100) \times (1 - Y_p / 100) \times (1 - B_{kp} / 100); \text{ and}$$

a color corrected value calculating section for determining corrected values (Ci', Mi', Yi', Bki') of color values (Ci, Mi, Yi, Bki) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (Ca, Ma, Ya, Bka) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%:

$$C_i' = C_i + C_a \times \alpha, M_i' = M_i + M_a \times \alpha, Y_i' = Y_i + Y_a \times \alpha \text{ and } B_{ki}' = B_{ki} + B_{ka} \times \alpha,$$

to thus replace the color values of the reference data with the corrected values.

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10. A color proofing apparatus for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing apparatus comprising:

a look-up table creating section for creating a look-up table including converted values of image data over the entire color space with respect to the proof press;

a noise strength and distribution amount input section for setting the noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press;

a paper color input section for specifying the color of the printing paper for the printing press;

a look-up table correcting section for correcting the look-up table based on the color inputted to the paper color input section and a paper exposed area factor in the proof print and

an image data converting section for changing the image data converted by the use of the look-up table corrected by the look-up table correcting section based on the noise strength and distribution amount inputted to the noise strength and distribution amount input section, to thus output the changed image data

in the case where the proof print is produced based on both of density gradation and area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent

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as not to need to take the ink transmittance into account, the look-up table correcting section includes:

an influence range input section for specifying an influence range defining how far reference data is influenced in the color space when the color values of the printing paper for the printing press are added to the color space; and

an influence value calculating section for determining an influence value for each of the reference data based on the color values of the paper and the value of the influence range, to thus add the influence value to the reference data.

11. A color proofing apparatus for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing apparatus comprising:

a look-up table creating section for creating a look-up table including converted values of image data over the entire color space with respect to the proof press;

a noise strength and distribution amount input section for setting the noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press;

a paper color input section for specifying the color of the printing paper for the printing press;

a look-up table correcting section for correcting the look-up table based on the color inputted to the paper color input section and a paper exposed area factor in the proof print and

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an image data converting section for changing the image data converted by the use of the look-up table corrected by the look-up table correcting section based on the noise strength and distribution amount inputted to the noise strength and distribution amount input section, to thus output the changed image data;

in the case where the colors of the printing paper for the printing press and a printing paper for the proof press are different from each other to such an extent as to need to take the ink transmittance into account, the look-up table correcting section includes:

a second color corrected value calculating section for determining corrected values (C_i' , M_i' , Y_i' , B_{ki}') of color values (C_i , M_i , Y_i , B_{ki}) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (C_a , M_a , Y_a , B_{ka}) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%, wherein address values (C_{id} , M_{id} , Y_{id} , B_{kid}) express the color values (C_i , M_i , Y_i , B_{ki}) by N-bit:

$$C_i' = C_i + C_a \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1));$$

$$M_i' = M_i + M_a \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1));$$

$$Y_i' = Y_i + Y_a \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1)); \text{ and}$$

$$B_{ki}' = B_{ki} + B_{ka} \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1));$$

to thus replace the color values of the reference data with the corrected values.

12. A color proofing apparatus for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing apparatus comprising:

an image data input section for receiving an input of proof printing image data over the entire color space in a subtractive process resulting from color matching between proof print produced by the proof press and the printed matter produced by the printing press; and

an image data correcting section for correcting the proof printing image data, in which each of levels of monochromatic color gradation of black on the printed matter is represented on the proof print, out of the image data inputted to the image data input section in such a manner that a part having a black ink area factor of 100% on the printed mailer is represented only with black ink also on the proof print, but that a part other than the part having a black ink area factor of 100% on the printed matter is represented on the proof print by using under color removal, to thus output the corrected image data.

13. The color proofing apparatus according to claim 12, wherein the image data correcting section includes:

a 100% black part image data correcting section for determining $\min(C_{100}, M_{100}, Y_{100})$ from color values $(C_{100}, M_{100}, Y_{100}, Bk_{100})$ of the proof printing image data for representing, on the proof print, the part having the black ink area factor of 100% on the printed matter, to thus determine a new value P of Bk_{100} ,

determining an addition value α_{100} for Bk_{100} in accordance with the following equation:

$\alpha_{100} = \min(C_{100}, M_{100}, Y_{100}) \times (P - Bk_{100}) / \min(C_{100}, M_{100}, Y_{100})$, wherein $1 \leq P \leq 100$, and then, adding the addition value α_{100} to Bk_{100} as well as setting all of C_{100} , M_{100} and Y_{100} to 0; and

a 99% or less black part image data correcting section for repeating, with respect to n from 99 to 1, the following processes of:

determining $\min(C_n, M_n, Y_n)$ from color values (C_n, M_n, Y_n, Bk_n) of the proof printing image data for representing, on the proof print, a part having a black ink area factor of $n\%$ on the printed matter;

determining an addition value α_n Bk_n in accordance with the following equation:

$\alpha_n = (\min(C_n, M_n, Y_n) - (100 - n)) \times (P - Bk_{100}) / \min(C_{100}, M_{100}, Y_{100})$, wherein $1 \leq P \leq 100$, to thus add the addition value α_n to Bk_n ; and

determining respective reduction values β_n , γ_n and δ_n of C_n , M_n and Y_n in accordance with the following equations:

$$\beta_n = \alpha_n \times ((P - Bk_{100}) / C_{100}),$$

$$\gamma_n = \alpha_n \times ((P - Bk_{100}) / M_{100}), \text{ and}$$

$\delta_n \sim \alpha_n \times ((P - Bk_{100}) / Y_{100})$, wherein $1 \leq P \leq 100$, to thus subtract the reduction values β_n , γ_n and δ_n from C_n , M_n and Y_n , respectively.

15. A recorded medium recording therein a color proofing program for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing program instructing the computer to execute the processes of:

creating a look-up table containing converted values of image data over the entire color space with respect to the proof press;

correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print;

creating proof print by the use of the corrected look-up table;

in the case where the proof print is produced based on only area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the look-up table correcting process includes the processes of:

determining a paper exposed area factor α in accordance with the following equation when arbitrary reference data P in the look-up table has color values (C_p, M_p, Y_p, B_{kp}) , each of which is N-bit data:

$$\alpha = (1 - C_p / (2^N - 1)) \times (1 - M_p / (2^N - 1)) \times (1 - Y_p / (2^N - 1)) \times (1 - B_{kp} / (2^N - 1)),$$

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in contrast, determining the paper exposed area factor α in accordance with the following equation when the arbitrary reference data P in the look-up table has the color values (Cp, Mp, Yp, Bkp), each of which is percentage data:

$$\alpha = (1 - C_p/100) \times (1 - M_p/100) \times (1 - Y_p/100) \times (1 - B_{kp}/100); \text{ and}$$

determining corrected values (Ci', Mi', Yi', Bki') of color values (Ci, Mi, Yi, Bki) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (Ca, Ma, Ya, Bka) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%:

$$C_i' = C_i + C_a \times \alpha, M_i' = M_i + M_a \times \alpha, Y_i' = Y_i + Y_a \times \alpha \text{ and } B_{ki}' = B_{ki} + B_{ka} \times \alpha,$$

to thus replace the color values of the reference data with the corrected values.

16. A recorded medium recording therein a color proofing program for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing program instructing the computer to execute the processes of:

creating a look-up table containing converted values of image data over the entire color space with respect to the proof press;

correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print:

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creating proof print by the use of the corrected look-up table;

in the case where the proof print is produced based on both of density gradation and area gradation and the colors of the printing paper for the printing press and a printing paper for the proof press are approximated to each other to such an extent as not to need to take the ink transmittance into account, the look-up table correcting process includes the processes of:

specifying an influence range defining how far reference data is influenced in the color space when the color values of the printing paper for the printing press are added to the color space; and

determining an influence value for each of the reference data based on the color values of the paper and the value of the influence range, to thus add the influence value to the reference data.

17. A recorded medium recording therein a color proofing program for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing program instructing the computer to execute the processes of:

creating a look-up table containing converted values of image data over the entire color space with respect to the proof press;

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correcting the look-up table based on the color of printing paper for the printing press and a paper exposed area factor in the proof print;

creating proof print by the use of the corrected look-up table;

in the case where the colors of the printing paper for the printing press and a printing paper for the proof press are different from each other to such an extent as to need to take the ink transmittance into account, the look-up table correcting process includes the processes of:

determining corrected values (C_i' , M_i' , Y_i' , B_{ki}') of color values (C_i , M_i , Y_i , B_{ki}) of arbitrary reference data I in the look-up table in accordance with the following equations when color values (C_a , M_a , Y_a , B_{ka}) of the printing paper for the printing press are added to a part where a paper exposed area factor is 100%, wherein address values (C_{id} , M_{id} , Y_{id} , B_{kid}) express the color values (C_i , M_i , Y_i , B_{ki}) by N-bit:

$$C_i' = C_i + C_a \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1));$$

$$M_i' = M_i + M_a \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1));$$

$$Y_i' = Y_i + Y_a \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1)); \text{ and}$$

$$B_{ki}' = B_{ki} + B_{ka} \times (1 - C_{id}/(2^N - 1) \times M_{id}/(2^N - 1) \times Y_{id}/(2^N - 1) \times B_{kid}/(2^N - 1));$$

18. The recorded medium recording therein the color proofing program according to claim 17, wherein the proof print creating process includes the process of:

changing image data converted by using the corrected look-up table based on the previously determined noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press, to thus create the proof print by the use of the changed image data.

19. A recording medium recording therein the color proofing program for improving the color reproducibility of printed matter to be produced by a printing press in proof print produced by a proof press by the use of a computer, the color proofing program further instructing the computer to execute the process of:

correcting proof printing image data, in which each of levels of monochromatic color gradation of black on the printed matter is represented on the proof print, out of the proof printing image data over the entire color space in a subtractive process resulting from color matching between proof print by the proof press and the printed matter by means of the printing press in such a manner that a part having a black ink area factor of 100% on the printed matter is represented only with black ink also on the proof print, but that a part other than the part having a black ink area factor of 100% on the printed matter is represented on the proof print by using under color

removal, to thus reproduce, on to proof print, the representing characteristics of the black ink on the printed matter.

20. The recorded medium recording therein the color proofing program according to claim 19, wherein the proof printing image data correcting process includes the processes of:

determining $\min(C_{100}, M_{100}, Y_{100})$ from color values $(C_{100}, M_{100}, Y_{100}, Bk_{100})$ of the proof printing image data for representing, on the proof print, the part having the black ink area factor of 100% on the printed matter, to thus determine a new value P of Bk_{100} ;

determining an addition value α_{100} for Bk_{100} in accordance with the following equation:

$$\alpha_{100} = \min(C_{100}, M_{100}, Y_{100}) \times (P - Bk_{100}) / \min(C_{100}, M_{100}, Y_{100}),$$
wherein $1 \leq P \leq 100$;

adding the addition value α_{100} to Bk_{100} as well as setting all of C_{100} , M_{100} and Y_{100} to 0; and

repeating, with respect to n from 99 to 1, the following processes of:

determining $\min(C_n, M_n, Y_n)$ from color values (C_n, M_n, Y_n, Bk_n) of the proof printing image data for representing, on the proof print, a part having a black ink area factor of $n\%$ on the printed matter;

determining an addition value α_n for Bk_n in accordance with the following equation:

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$a_n = (\min(C_n, M_n, Y_n) - (100 - n)) \times (P - Bk_{100}) / \min(C_{100}, M_{100}, Y_{100})$, wherein $1 \leq P \leq 100$, to thus add the addition value a_n , to Bk_n ; and

determining respective reduction values β_n , γ_n and δ_n of C_n , M_n , and Y_n , in accordance with the following equations:

$$\beta_n = \alpha_n \times ((P - Bk_{100}) / C_{100}),$$

$$\gamma_n = \alpha_n \times ((P - Bk_{100}) / M_{100}), \text{ and}$$

$\delta_n \sim \alpha_n \times ((P - Bk_{100}) / Y_{100})$, wherein $1 \leq P \leq 100$, to thus subtract the reduction values β_n , γ_n , and δ_n , from C_n , M_n , and Y_n , respectively.

21. The color proofing method according to claim 2, wherein the step of creating the proof print includes the step of:

changing image data converted by using the corrected look-up table based on the previously determined noise strength and distribution mount indicating the level of a variation of the color of the printing paper for the printing press, to thus make the proof print by the use of the changed image data.

22. The color proofing method according to claim 3, wherein the step of creating the proof print includes the step of:

changing image data converted by using the corrected look-up table based on the previously determined noise strength and distribution mount indicating the level of a variation of the color of the printing paper for the printing press, to thus make the proof print by the use of the changed image data.

23. The recorded medium recording therein the color proofing program according to claim 15, wherein the proof print creating process includes the process of:

changing image data converted by using the corrected look-up table based on the previously determined noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press, to thus create the proof print by the use of the changed image data.

24. The recorded medium recording therein the color proofing program according to claim 16, wherein the proof print creating process includes the process of:

changing image data converted by using the corrected look-up table based on the previously determined noise strength and distribution amount indicating the level of a variation of the color of the printing paper for the printing press, to thus create the proof print by the use of the changed image data.